Art. II.—*Notes on the Quality of Hartley and Greta Shale for the Manufacture of Gas, together with a Description of the New Coal Seam at Greta.* By A. K. Smith, C.E., F.R.S.S.A., &c. &c.

[Read 4th October, 1869.]

I have been recently engaged in a neighbouring colony testing some of the coals and shales from the districts of Hartley and the Hunter River, in New South Wales, principally for ascertaining their value for luminiferous purposes. I now beg to submit a brief account of the results arrived at.

I may premise that the experiments were made at the request of the provisional committee of the Consumers' Gas and Oil Company, Sydney, for the sole purpose of determining the value of Hartley shale for the manufacture of gas, to be used either by itself or to enrich (by mixture) the gas obtained from the ordinary Hunter River (Newcastle) coal.

EXPERIMENT WITH HARTLEY SHALE.

Having examined the shale, I had it broken up into small pieces, and carefully weighed 224 lbs., with which I charged two fireclay retorts, first having noted the index of the station-meter to be standing at 5,586,294. Charging the retorts commenced at 10h. 27m. 40s. a.m., and finished at 10h. 30m. a.m.. thus occupying 2m. 20s. in the operation. At—

Mins.	h. m.					
7	10.37	the meter	indicated the	production of	100	feet gas.
9½	10.46½	"	"	"	200	"
10	10.56½	"	"	"	300	"
10	11. 6½	"	"	"	400	"
10½	11.17	"	"	"	500	"
11½	11.28½	"	"	"	600	"
12½	11.41	"	"	"	700	"
13	11.54	"	"	"	800	"
13	12. 7	"	"	"	900	"
19	12.26	"	"	"	1000	"
24	12.50	"	"	"	1100	"
23	1.13	"	"	"	1126	"

163
2 165 = 2h. 45m.

At 1h. 13m. the station meter indicated		5,587,420 feet.
At the commencement	... ...	5,586,294 ,,
		1,126 ,,

A reference to the above times and quantities will show, that the first 100 feet of gas was given off in seven minutes from the time of closing second retort, or nine minutes and twenty seconds from commencement of charging the first retort.

The	second in		9½	minutes.
,,	third	,,	10	,,
,,	fourth	,,	10	,,
,,	fifth	,,	10½	,,
,,	sixth	,,	11½	,,
,,	seventh	,,	12½	,,
,,	eighth	,,	13	,,
,,	ninth	,,	13	,,
,,	tenth	,,	19	,,
,,	eleventh	,,	24	,,
,,	twelvth ·26	,,	23	,,
	1126 feet		165m. 20s. = 2h. 45⅓m.	

thus showing the total quantity of gas made from 224lbs. of shale to be 1126 cubic feet, or at the rate of 11,260 feet per ton.

The retorts were at a fair average heat and burned out or exhausted the charge in 2h. 45⅓ mins.

In making this experiment I had intended taking the illuminating power of the gas as it was produced, but on account of the light from the burner consuming five feet per hour, being abnormally large and above the power of my photometer to register, I lost a few minutes in procuring a small burner: this, to a certain extent, destroyed the accuracy of the experiment; and although I continued taking the quality of the gas, I thought it advisable to set aside the results, which were on the whole slightly in excess of those subsequently obtained (the actual difference being as 51·53 is to 51·51.)

I then commenced the second experiment, with the same quantity of shale—viz., 224 lbs,, with which I charged three clay retorts—

Retort.		Commenced at.				Finished.			Time Occupied.
		h.	m.	s.		h.	m.	s.	
1st	..	1	19	0	p.m.	1	19	33 p.m.	33 seconds.
2nd	..	1	19	40	,,	1	20	20 ,,	40 ,,
3rd	..	1	20	22	,,	1	21	10 ,,	48 ,,

Averaging forty seconds for the time expended in charging each retort. The total quantity produced amounted to 1,128 cubic feet from 224 lbs. coal in 2 h. 29 min., or at the rate of 11,280 feet per ton of shale, thus showing a very close approximation to the quantity produced in the first experiment, the difference being only an increase of 20 feet, or at the rate of one foot per cwt.

You will observe that the time occupied was less than in the former experiment. This arose from the quantity being used in three retorts instead of two, thereby reducing the quantity in each retort.

Previous to commencing this experiment I had prepared a small burner, and had carefully weighed and noted the weight of the sperm candle to be used. At the conclusion of the experiment I found the experimental meter indicated a consumption of 2·2 cubic feet per hour, and that the candle had been burning 136 grains per hour. At various times during the distillation of the coal I tested the quality of the gas, and recorded its illuminating power.

Each value I noted was the average of ten observations, and resulted in showing an average illuminating power of 20·014 candles (say 20 candles) then as—

$$2{\cdot}20 \ : \ 5 \ :: \ 20 \text{ to } 45{\cdot}45$$

However, as the candle consumed 136 grains per hour, instead of the standard quantity of 120 grains, it was required to find what number of standard candles was represented by 45·45, thus—

$$\therefore \ 120 \ : \ 136 \ :: \ 45{\cdot}45 \ : \ 51{\cdot}51 \text{ candles.}$$

After making various other experiments, both as to quality and quantity, I obtained the following results as the average of the whole, viz. :—That the shale produces marketable gas at the rate of 11·280 cubic feet per ton ; that 5 cubic feet of the said gas gave a light equal to that derived from or afforded by 51·51 sperm candles, each consuming at the rate of 120 grains per hour ; and that one foot of gas gave a light equal to that derived from 1,236·24 grains of sperm ; and finally that one ton (2,240 lb.) of Hartley shale produces the same amount of light as 1,992 lb. of sperm candles.

Subsequently I weighed off 100 lb. shale, and after carbonizing the same, I carefully weighed the coke, &c., and found that it amounted to 32½ lb., thus showing that the volatile matter given off in the destructive distillation of Hartley shale amounted to $67\frac{1}{2}$ per cent. I also experimented upon another description of shale, with the following results :—It produced 14,136 cubic feet per ton ; 5 feet gave a light equal to 37·62 candles ; one foot was equal to 902·88 grains of sperm ; and one ton gave a light equal to 1,823·3 lb. sperm candles. In order that you may compare the Hartley shale with Bog Head cannel coal, I now append the value of that coal, as given by the agents in their circular to gas companies, and as published in the journal of gas lighting :—

Bog Head cannel coal, or Torbane Hill mineral, produces 13,500 feet per ton.

One foot equal to $8\frac{1}{2}$ sperm candles, or 1,020 grains.

One ton equal to 1,967·14 sperm candles.

In the Agents' circular it is stated to be equal to 1,990 lb. sperm candles ; but when worked out according to the above description, the result is, as before stated, 1,967·14 lb. Ordinary British Newcastle caking coal is only equal to 420 lbs. of sperm candles.

The other description of shale I experimented upon, although not quite so rich as the Hartley shale, is still of great value ; and thinking that a brief account of the seam from which it was taken would be of interest to the members of this Society, I procured copies of the Reports of William Keene, Esq., F.G.S., Examiner of Coal-fields, N.S.W., from which the following are extracts :—

"Newcastle, 14th January, 1869.

"To Michael Fitzpatrick, Esq.,

"Under Secretary of Lands, Sydney,

"Sir,—I have the honour to forward herewith, for the further information of the Honorable the Secretary for Lands, plan and sections showing the great seam opened by me in Anvil Creek, at Greta, in which petroleum oil coal, and other varieties of coal, are found in a thickness altogether of 22 feet."

The following is a description of a section of the seam opened in the creek, and subsequently proved by a trial shaft at a depth of 40 feet :—

Ft.	In.	Description.
0	3	Shale
2	0	Bituminous Coal
0	3	Bright Coal
0	2	Resurite
1	0	Petroleum Oil Coal
2	3	Bright Coal
1	6	Splint Coal
1	6	Woody Coal (good)
0	4	Brown Clay Band
1	1	Woody Coal (good)
1	0	Fire Clay
0	3	Coaly Band
0	8	Fire Clay
0	11	Coaly Band
1	0	Fire Clay (grey)
0	6	Brown Fire Clay
5	9	Coal (excellent)
1	6	Brown Shale
4	3	Coal (excellent)
1	6	Fire Clay
27	8	Grit and Conglomerate Rocks
1	0	Petroleum Oil Coal
18	9	Coal
7	11	Fire Clay, Coaly Band, &c.
27	8	

Subsequently, on the 4th July, 1869, Mr. Keene reports to the Under Secretary for Lands, Sydney :

" Sir,—I have the honour to report to you for the information of the Minister for Lands, under the date of the 30th April, 1868, the discovery of petroleum coal in the Greta field.

" A continuation of this research has led to the further discovery in the last few days of what I believe to be the bottom seam of the Carboniferous Deposit in our coal field, and this coal, like to that of the seam above it, and which contains the petroleum coal, is of most excellent quality. I have not yet been able to ascertain the thickness of this bottom seam . . . .

" Signed. William Keene.

" Examiner of Coal Fields."

I now produce samples of the Greta or Anvil Creek coal, and petroleum shale, together with the section of the seam.

Of the quality of the shale for gas making purposes I have before spoken, but the small slips I have sawn from the specimens before you will show that they can be easily ignited, and that they burn like a candle or vesta match.

Next to their quality, perhaps the most important feature respecting the shale and coal from this seam is the statement that they can be put on board at Newcastle at the same (or a little less) cost as the ordinary coal mined within two miles of the port.

The supply of coal to Melbourne and its suburbs is now becoming of great importance. The quantity used by the Government railways, engineering establishments, flour mills, paper and sugar manufactories, distilleries, breweries, and other industries requiring steam power, shows a rapidly increasing demand; a demand that is accelerated on account of the distance from which firewood has to be brought, and its consequently enhanced price. Coals are also being used extensively for domestic purposes, especially in houses of the better class, and therefore the quality and price is an object of general interest, and one that demands occasional investigation.

The quality of the coals in New South Wales changes very much. For instance, coals that I tested five years ago for the Melbourne Gas and Coke Company, were then of a very superior description, lately, the coals from the same pit I find are much deteriorated, containing more impurities, less gas, and that of a very inferior quality. As the coals here referred to are used for the generation of steam, the change in their quality must have prejudicially affected them for that purpose; also, the demand for gas coal has now reached about 30,000 tons per annum, and this demand may be expected to still further increase, if gas should be employed for cooking purposes.

Mr. Lewis Thompson, the celebrated analytical chemist, in a pamphlet published by him, refers as follows to the use of gas as a calorific agent:

"To obtain a perfect estimate of the relative money values "of gas and coal as calorific agents we must begin by tak-"ing a comprehensive view of the contingencies inseparably "attached to both, and perhaps when the expense and "inconvenience arising from soot, smoke, and ashes, are "added to the cost of coal in the shape of labour for cleans-

"ing rooms, furniture, and chimneys, together with the "damage thus created, we shall find no great reason for con- "cluding that the general use of gas as a heating agent, is "either an impossible or an improbable event in the pro- "gressive march of real civilization."

Mr. Thompson's remarks are made for, and applied to, a climate much colder than that of these colonies, and where heat at most seasons of the year is enjoyable rather than otherwise; but a cheap supply of good gas for heating and cooking purposes is a matter of more importance here than in the British Isles, inasmuch as in this climate, where the temperature ranges in summer from 70° to 100° Fah., the principal desideratum is to avoid as much as possible the use of fire for cooking purposes. In the country districts fires can be, and are, generally made out of doors; and thus the heating of dwelling-house apartments is avoided. However, in the city, this can rarely be done, on account of the danger and inconvenience of open-air fires. It only requires a little time to prove beyond all doubt that ordinary culinary operations can be performed at less cost with gas, in conjunction with the use of Norwegian heat-retaining stoves, than by any other means; that is if freedom from dust, a longer duration of heat, a greater economy of time, and a less necessity of unremitting attention, be considered of any monetary value.

Art. III.—*η Argûs and surrounding Nebula.* By A. Le Sueur, Esq.

[Read 14th February, 1870.]

At the request of your president I have drawn up the following account of some observations which I have lately made with the great Melbourne telescope.

One important fact elicited may be stated in few words; the spectrum of the star η Argûs is crossed by bright lines.

The abnormal variations in magnitude to which this star is subject gave reason to expect that some peculiarity in its light would be revealed by the spectroscope; as soon, therefore, as the instrumental and atmospheric conditions were sufficiently favourable, a careful examination was made.

The first night employed was fortunately a good one, so that the bright line character, which might otherwise have easily escaped notice, was at once suspected.